

蝶と蛾 *Tyô to Ga*, **39** (4): 235–240, 1988

Adult Dispersal and Exploitation of New Habitat in the Aphidphagous Butterfly, *Taraka hamada* (Lepidoptera, Lycaenidae)

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Abstract The adult dispersal in the aphidphagous lycaenid, *Taraka hamada* was studied by using the marking method. The results demonstrated that the butterflies dispersed to search new habitats. The butterflies seemed to move along the forest edge, where the larval food, the aphid, *Ceratokacuna japonica*, usually occurred. Eight females and two males were observed to immigrate into new places. The adult dispersal should be an important strategy for *T. hamada* to maintain the population, because this species depends on the unstable food resource.

Introduction

The aphidphagous lycaenid, *Taraka hamada* DRUCE depends on the aphid, *Ceratokacuna japonica* TAKAHASHI, in the lowland of Kantou district: the larvae eat the aphid and the adults feed on honeydew of the aphids. Since the aphid is distributed locally, the habitable place for the butterfly is also limited. The population size of aphid greatly changes from late spring to early autumn and the extinctions often occur by the predation of the butterfly larvae (BANNO, 1985).

Many studies have been made on the dispersal of butterflies, which is one of the important fields in the butterfly ecology. The movement of adult butterflies and its role for the life histories vary from species to species. The exploitation of new habitat may be one of the important roles of female movement (JOHNSON, 1966). The adult dispersal is considered to be also important for *T. hamada* whose populations are affected by the unstable food resources. The present study elucidates the adult dispersal and its role in *T. hamada*, as a series of the previous work (BANNO, 1985).

Study Area and Methods

The study area is situated in Tsukuba city, Ibaraki Prefecture and consists of pine forests, plowed fields, paddy fields and residential sections (Fig. 1). The study was carried out from May to August 1982 at seven places in this area, one as the main site and six as sub-sites (see Fig. 1).

The main study site was the pine forest (*Pinus densiflora* SIEB. et ZUCC.), whose floor was dominantly covered with the bamboo grass (*Pleiblastus chino* MAKINO). The aphid, *C. japonica*, was found in various sizes of colonies on the underside of the

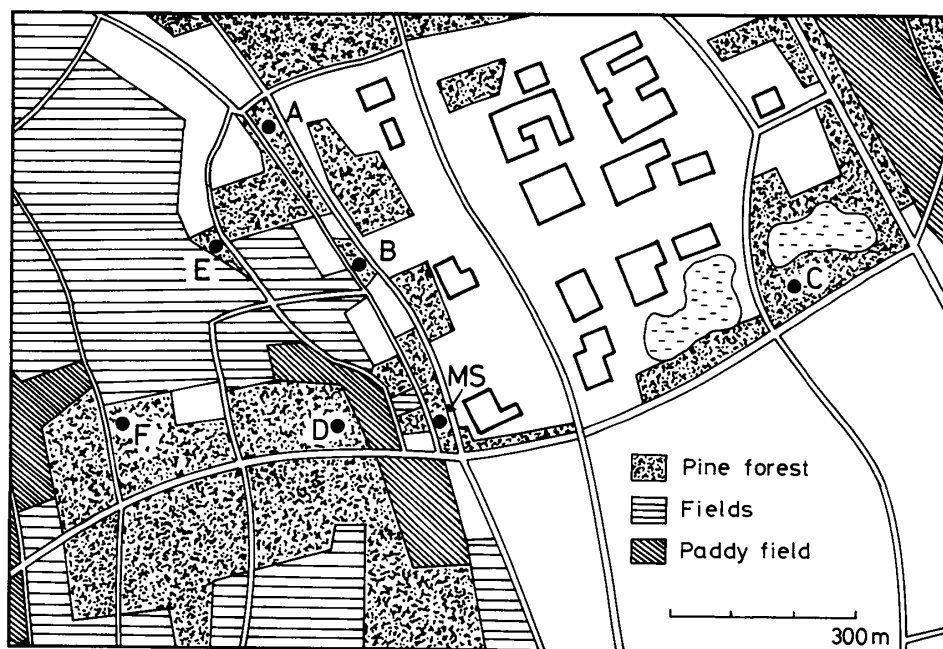


Fig. 1. Map of study area. MS and A-F show main site and sub-sites, respectively. Clear parts in the map are the campus of university and residential sections.

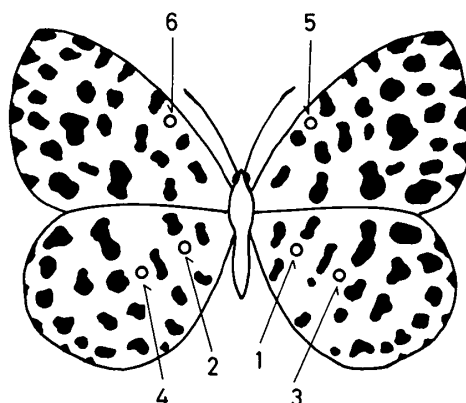


Fig. 2. Marking positions on the wings of butterfly.

bamboo leaves. There was no *T. hamada* within a 500 m circle of the main site.

The sub-sites were also dominated by pine trees, and their vegetations were similar to that of the main site. The aphid originally occurred in three sites (A, B, C), and the butterfly did in two sites (A, C). In the other three sites (D, E, F), the aphid (about 20–30 colonies) were artificially transplanted in March, 1982.

All the butterflies observed in both the main site and the sub-sites were marked individually in water proof colour pens. The marking was made to the undersides of hind wings in the main site and to the costal margins of fore wings in the sub-sites (Fig. 2). The marks were different among the sub-sites. In each site, the butterflies were captured, examined the marks and released every one or two days. Individuals without marks were marked and released.

Results

More than a hundred of adults of *T. hamada* were marked from May to August in the main site. The immigrant butterflies were recaptured in three sub-sites. On June 23, one male and one female from the main site were recaptured at the sub-site A (about 500 m distant from the main site). They were two of the 23 individuals marked within the past 5 days. They were proved to be recaptured on the 4th or 5th day after the marking. At the sub-site B (about 300 m distant from the main site), two females from the main site were caught on June 27 and on August 23, and also one female from sub-site A on August 12. Each butterfly was one of 34, 56 and 21 individuals marked within the past 5 days. They were recaptured 5, 3 and 2 days after the marking, respectively. One non-marked female was also found on July 26. At the sub-site D (about 200 m distant from the main site) one female from the main site was recaptured on July 28. This was one of 30 individuals marked within the past 5 days. Furthermore, non-marked one male and one female were caught at the sub-site E (about 400 m distant from the main site) on August 4, and one non-marked female was also found at the sub-site F (about 600 m distant from the main site) on July 28. In these two sub-sites, the aphid and butterfly did not originally occur. No individual from the sub-site C was captured in other sites, and no immigrant from other sites was caught in the sub-site C. Six butterflies were observed to move from site to site through the study period, though the number is small compared with the number of marked butterflies. Out of the six butterflies, five were female and only one was male.

In the spring of 1982, the larvae of *T. hamada* did not occur in the sub-site B. After marked females were found to immigrate from the other sites in June as stated

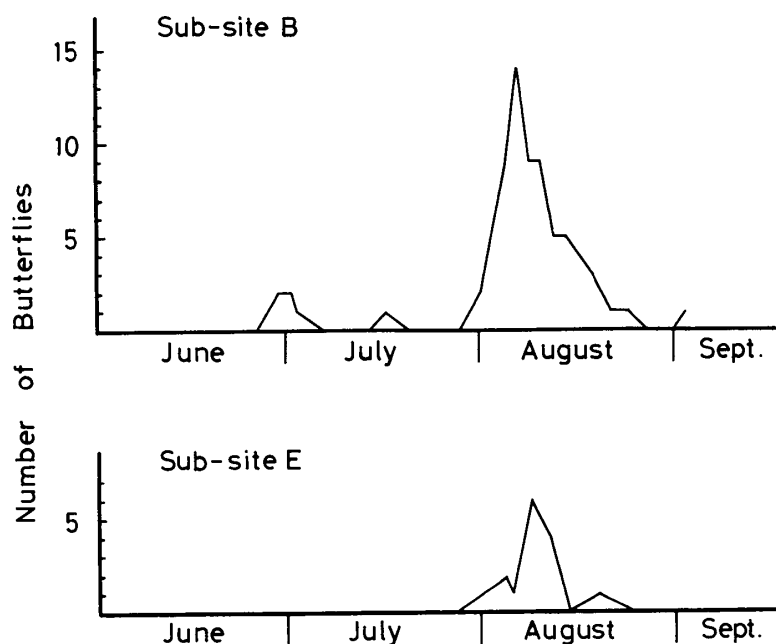


Fig. 3. The changes in the number of butterflies in sub-site B (upper) and sub-site E (under).

above, the larvae were observed from mid to late July. The adult butterflies began to emerge in early August, and reached the peak in number on August 6 (Fig. 3). These butterflies were considered to be the offspring of the females which had immigrated into this sub-site.

At the sub-site E, where *T. hamada* did not occur originally, several adult butterflies were caught from mid to late August (Fig. 3) after the first capture on August 4. Since the marks of predation to aphids by the larvae were observed there, the butterflies were also considered to be the offspring of the immigrant butterfly. Judging from the developmental time required from egg to adult emergence, the mother butterfly was supposed to arrive at the site in July.

Discussion

In the present study, the adults of *T. hamada* were observed to move from the main site to sub-sites, although the recaptured butterflies were small in number. Since the aphid, *C. japonica* occurs quite locally, there is a little probability that the butterfly can reach the place where the aphid colonies exist. Therefore, more butterflies than actually observed may have flown out from the main site. KOHIYAMA *et al.* (1971) reported that females of *T. hamada* sometimes went out from the emergence places. The butterflies were sometimes observed flying at the places where aphids did not occur and several non-marked immigrants were captured in three sub-sites in this study. The facts suggest that some individuals move in order to search for new habitats in this lycaenid. The butterflies may disperse along the forest. Indeed, this species were often observed flying at forest edge, and the majority of recaptured adults moved from the main site to the sub-site A or B in this study. Since the aphid, *C. japonica*, usually occurs at forest edge, the movement along forest may lead the dispersing butterflies to the new habitats. There was no exchange of adults between the sub-site C and every other site. The residential section and the university campus may constitute the insuperable barrier to the dispersing butterflies.

The adult dispersal may be related to the abundance of larval and adult food resource in *T. hamada*. The decrease of aphid colonies causes the shortage of adult feeding sites as well as oviposition sites. As shown in Fig. 4, the adult disappearance rate in the main site was higher in the late flight season (the aphid is few) than in the early season (the aphid is abundant). Furthermore, in the previous study (BANNO, 1985), where the aphid was artificially protected from the predation of the butterfly larvae at one part in the main site, several females were observed to move into the part. Most movements were recorded from August when the aphid had decreased in other parts.

Some butterflies were observed to emigrate from the main site even when the aphids were still abundant. This suggests that other factors may also influence the dispersal of the butterflies. SHAPIRO (1970) reported that the female's dispersal was affected by males. In the pierid *Colias lesbia*, the females avoided males after copulation (BERNSTEIN, 1980). In general, it is desirable that females concentrate their energies on the oviposition after copulation. The intervention by males may necessar-

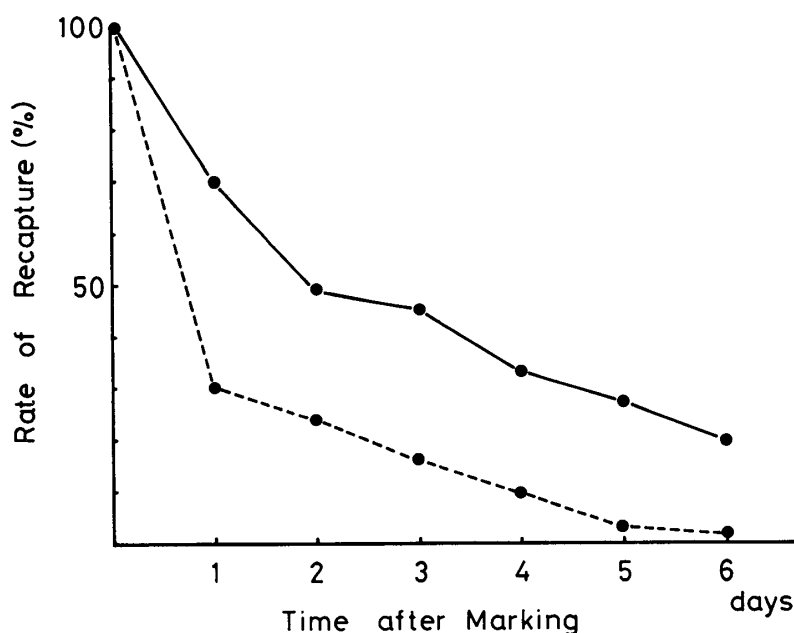


Fig. 4. The recapture duration decay curves for butterflies in the main site. Marking days: plain line for June 29–July 3; broken line for August 18–22.

ily increase as the population density increases. The female's movement may be also affected by male in *T. hamada*.

Out of the ten butterflies (both marked and non-marked) observed to move in the present study, eight were females and two were males. Females may have a tendency to move than males. In many butterfly species, females are known to copulate immediately after emergence, and males remain on the original site to have more chances to copulate with unmated females (WARREN, 1987).

JOHNSON (1966) demonstrated that the function of female's dispersal is the oviposition at new habitats. The adult dispersal is considered to be an important strategy to exploit new habitats in *T. hamada* which is often exposed to the shortage of larval foods and to the disappearance of habitat. FUKUDA *et al.* (1972) reported that *T. hamada* often appeared in the place where they had not used to be. The unexpected appearance in a new place may be explained by the assumption that the females of *T. hamada* disperse to establish the population in a new place.

Acknowledgements

The author expresses his sincere thanks to Drs. J. MISHIMA and M. ISHII for critical reading the manuscript. Thanks are also offered to Drs. H. KUROKAWA, H. IWAKI and K. FUJII for their valuable comments and helpful advice on this study.

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摘 要

ゴイシシジミの成虫の分散と新生息地の開拓（伴野英雄）

ゴイシシジミの成虫の分散と新生息地の出現についての研究を、1982年に茨城県つくば市内のアカマツ林、畑、水田、宅地がパッチ状になっている調査地で行った。調査地内にゴイシシジミの大きな生息地であるメインサイトと、6か所のサブサイトを設けた。各々のサイトで成虫の翅の裏面に油性の極細マーカーを用いてマークをし、成虫の移動を調べた。サブサイトの内2か所はゴイシシジミ、ササコナフキアブラムシとも生息していた場所、1か所はアブラムシのみ生息していた場所、他の3か所は人為的にアブラムシを移植して作った場所である。いずれもアカマツ林で、アブラムシは林床のアズマネザサに寄生していた。

サブサイトにおいて、メインサイトからの移動個体、及び出発地は不明であるが明らかに移動してきたと考えられる個体が捕獲され、ゴイシシジミの成虫がアブラムシの生息地を求めて移動することが確かめられた。またゴイシシジミがもともと生息していなかったサブサイトで、移動個体の子孫と考えられる個体の発生が確認された。捕獲された移動個体は雌が雄より多かった。

ゴイシシジミの食物であるアブラムシの量は季節により大きく変化し、全く食い尽くされてしまうことも稀でない。このように量的に不安定な食物を利用しているゴイシシジミにとって、成虫のアブラムシ生息地への移動は、個体群を維持して行くための一つの重要な手段と考えられる。また成虫の移動は、アブラムシの移動と共に、新生息地の出現の機構でもありと思われる。